

TITLE  13-184 FM TRANSMITTER		LOCKHEED AIRCRAFT CORPORATION MISSILE SYSTEMS DIVISION		TEST PROCEDURE ACCEPTANCE MOO9887 B
X7A-3		SHEET 1 OF 9 SHEETS		
PREPARED  H. Wagner	TEST-DEPT V Blue Mfg. Test Engrg. Dept. 31-10	DESIGN-DEPT R.D	RELEASE 8-19-57 (5)	

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## REVISIONS

SYM	DATE	DESCRIPTION	FOR TEST	FOR DESIGN
	1-15-58	Was ATP 1012 "B" (completely revised)		R. Donahue, 51-46
"A"	<del>8-22-58</del> B.7.	Data Sheet Revised Center Frequency was "0.02%" is "0.01%" Frequency Deviation & R.F. Power Deviation tests deleted.	V Blue	J. Manno 8-20-58
		Added Schematic Dwg to Ref. Change in para. 2.3. An addition to para. 2.5. A change in para. 2.9 Added para. 2.10. An addition to para. 5.4 Change in para. 5.4.6. Changed para. 6.2.2 and added para. 6.2.2.1, 6.2.2.2 and 6.2.2.3 and 6.2.9. Added "self oscillation" to Data Sheet.		
"B"	6-11-59 md	Changed Paragraph 6.2.6	H. B. Logner	S. J. Nerone 6/11/59



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### References:

Vendor's MSD Feb.

Acceptance Test Spec. 1009887B

Primary Use: Telemetry

Schematic Diagram 1016747-B

E.O. 48287 & 48219

## 1. Inspection Characteristics

- 1.1 Frequency.
- 1.2 Power output.
- 1.3 Mod. sensitivity.

## 2. Reference Inspection

- 2.1 Plate Voltage 250 VDC.
- 2.2 Filament voltage.
- 2.3 2nd amplifier plate current 20 MA Max.
- 2.4 2nd amplifier grid current 2 to 8 MA Nom.
- 2.5 Power output 1.7 watts minimum; 2 watts maximum.
- 2.6 Operating frequency  $\pm .01\%$  of frequency specified for transmitter.
- 2.7 Modulation sensitivity 1.5 to 3.0 RMS for 125 KC deviation.
- 2.8 Carrier and Second upper sideband rejection 30 DB Min.
- 2.9 Distortion 2% maximum with a sine wave mod. signal of 1000 cps and a Freq. deviation of 125 KC.
- 2.10 Total plate current shall not exceed 95 ma.

## 3. Test Equipment

- 3.1 NIE power supply 0-8 VDC and 0-300 VDC.
- 3.2 Test panel 1012.
- 3.3 Hewlett Packard 524B counter.
- 3.4 Hewlett Packard 330B distortion analyzer.
- 3.5 Hewlett Packard 400D voltmeter.
- 3.6 Clark receiver FM.
- 3.7 Hycon oscilloscope
- 3.8 Hewlett Packard 200 CD oscillator.
- 3.9 Simpson Volt-ohm-meter.

Reference:  
Bureau of Land Management  
Washington, D.C. 20250

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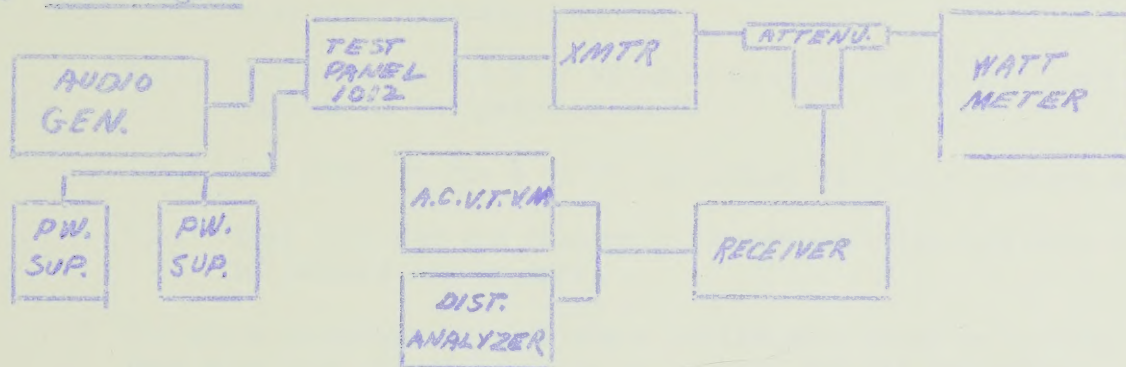
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3.10 General Radio attenuator.

3.11 Hewlett Packard 410B VTVM

#### 4. Test Diagram



#### 5. Preliminary Test Procedure

- 5.1 The following is written as a procedure to the technician and is not to be verified by Quality Control until stipulated.
- 5.2 Remove cover and give transmitter a visual inspection for broken wires, tubes, components, or tuning capacitors that have been bent permitting plates to touch each other.
- 5.3 Check continuity between power plug

<u>PIN</u>	<u>CIRCUIT</u>	<u>RESISTANCE TO GROUND</u>
A and	Ground	should be 0 ohms
B and	B+	should be 00 ohms
C and	Filament	should be .5 ohms
D and	Input	should be 00 ohms

- 5.4 Install Lab set resistor (R5). This may be a potentiometer with a valve of 0-100K, and lab set resistor (R20) 330 ohms.

- 5.4.1 With zero modulation on input of multivibrator and filament on, turn B+ to 135 to 140 VDC with B+ voltage 75 indicated on test panel 1012.
- 5.4.2 Put input leads of 524B counter to junction of R8 and R7. The counter should indicate a frequency according to Chart I. If not on frequency, vary potentiometer until counter indicates near the desired frequency. This does not constitute the final adjustment. It is made after full B+ is applied.
- 5.4.3 Put DC probe of 410D on grid (Pin 7) of V5B and vary L2 until a voltage maximum occurs.



### Appendix 1: Glossary

- 1.1 The following is a list of the terms used in this document.
- 1.2 Some terms are defined in the text of the document.
- 1.3 Other terms are defined in this appendix.
- 1.4 The following table lists the terms and their definitions.

Term	Definition
Host Computer	A computer system that provides the main processing power for the system.
Control Unit	The unit that controls the operation of the system.
Data Base	A collection of data that is used by the system.
Terminal	A device that allows a user to interact with the system.
Printer	A device that prints out the output of the system.
Backup Unit	A unit that is used to back up the data in the system.

1.5 The following table lists the terms and their definitions.

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1.8 The following table lists the terms and their definitions.

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- 5.4.4 Then apply probe of 400 GD to grid (Pin 7) of V6 and vary C15 until a voltage maximum occurs. There is no set voltage maximum or minimum that grid should read on any one tube, but if there is 0 or a plus voltage on the grid, it is an indication that the stage is faulty with exception of Pin 5 on V7 which will read approximately 1V.
- 5.4.5 Put probe on Pin 7 of V8 and adjust L1 and L4 for a voltage maximum as indicated on 410D.
- 5.4.6 Put probe on Pin 1 of V7 and adjust C29 for a voltage minimum.
- 5.4.7 Then vary C38 and observe Bird wattmeter for 1.0 watt output of transmitter or more.
- 5.5 The above paragraphs constitute a preliminary check on transmitter. They show that the transmitter is working but not calibrated.
- 5.6 For final calibration, turn B+ up to 250 VDC as indicated on test panel "1012".
- 5.6.1 Set up 524B counter as follows.....
- 5.6.2 Set "mixing frequency" to applicable freq. and function switch to "mixer" position on 525B.
- 5.6.3 Set function selector to "frequency" position and "gain" control knob is adjusted until tuning eye just closes.
- 5.6.4 Turn frequency until selector knob to "1" position and "man gate" to open.
- 5.6.5 "Std. frequency Ctd" switch is set to 100 KC position and "100 KC STD" to "int".
- 5.6.6 Put probe of 524B to junction of R7 and R8 and adjust pot R5 until a frequency according to Chart I is read +1%.

#### CHART I

Multivibrator Frequency for output frequency of transmitter of

225 MC	is	1.200 MC
229 MC	is	1.400 MC
233 MC	is	1.500 MC

- 5.6.7 Tune clark receiver until discriminator microammeter indicates "0" and signal level meter indicates maximum signal level. This indicates receiver carrier frequency tuning is correct.



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5.6.7.1 Adjust attenuator until a reference level of 100 is indicated on signal level meter on Clark receiver.

5.6.8 Connect Counter 524B to output of transmitter. The output frequency unmodulated shall be .01% of center frequency as specified on work orders. If frequency is not according to work order, vary R5 Pot until complied with.

5.6.9 Apply 1000 CPS modulation to input of multivibrator with Hewlett Packard 200 oscillator.

5.6.9.1 The RMS value of the modulating voltage shall not be less than 1.5 VRMS or more than 3.0 VRMS for a frequency deviation of 125KC. Peak voltages are 2.22V and 4.24V respectively for 1.5 VRMS and 3 VRMS as measured from input to ground.

5.6.9.2 The frequency deviation will be proportional to the voltage output of the Clark receiver as read on the 200 CD voltmeter. This output voltage in RMS value has been calibrated according to the individual gain of the receiver and is printed on calibration stamp on the panel of the receiver. The receiver shall be calibrated for the above function by lab standards group (Orville Johnson).

5.7 Tune up transmitter by the methodical adjustment of following variable inductors and capacitors (L2, C15, L4, L1, C25, C29, C13 and C38). The maximum output should then exceed 1.7 watts as indicated on Bird Wattmeter.

5.7.1 Tune Clark receiver to transmitter output frequency and readjust attenuator until signal level meter reads 100 and center frequency indicator reads "0" and then note reading on attsmuator.

Tune receiver to carrier frequency of transmitter which for

225 MC	transmitter is	223.8 MC
227.5 MC	" "	226.0 MC
229 MC	" "	230.4 MC
233 MC	" "	234.5 MC

and adjust attenuator until signal level meter reads 100.

5.7.2 Note reading on attenuator and subtract from previous reading. It should be 30 DB difference or more. If not, adjust C15 until a value of 30 DB is obtained with no change in output.

RESEARCH REPORT

1.1. The purpose of this research is to investigate the effects of the proposed system on the performance of the system.

1.2. The research is conducted in the form of a case study, where the proposed system is implemented in a real-world environment and its performance is monitored and evaluated.

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Prepared	NAME D. Burton	DATE 8-19-57	LOCKHEED AIRCRAFT CORPORATION MISSILE SYSTEMS DIVISION	FIG. 1	FORM
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5.7.3 Tune receiver to 2nd upper sideband which for

225 MC	transmitter is	226.2 MC
227.5 MC	"	229.0 MC
229 MC	"	230.4 MC
233 MC	"	234.5 MC

and adjust attenuator for a reading of 100 on receiver signal level meter. Note reading on attenuator and subtract this value from the reading obtained from transmitters' first upper sideband or center frequency. This value should exceed 30 DB as read on attenuator.

5.7.4 If this number is less than 30 DB, readjust L1 and L4 for minimum reading on signal level meter without decreasing wattmeter reading.

5.7.5 Replace cover and return for maximum output on Bird wattmeter.

5.7.6 Connect distortion meter to demodulated output of receiver. The distortion should not exceed 2%.

6. The following paragraph shall be verified by Quality Control.

6.1 Connect as per test diagram.

6.2 B + shall be 250 VDC after a ten minute warmup.

6.2.1 Filament voltage shall be 6.3 volts.

6.2.2 The following values are read from the 1000 test panel indications with the transmitter output exceeding 1.7 watts as indicated on the Bird-wattmeter.

6.2.2.1 The output plate current shall not exceed 20 MA. ( If it does exceed 20 MA increase the value of the lab set resistor R20 ).

6.2.2.2 The grid current shall not exceed 8 MA.

6.2.2.3 The total transmitter plate current shall not exceed 35 MA.

6.2.3 Read the output frequency on 520B counter. This frequency shall be  $\pm .01\%$  of frequency specified on Work order for transmitter.

6.2.4 The modulation sensitivity shall be read directly from the 1000 CPS output of the receiver on a 400 CD voltmeter. The frequency swing is proportional to the output amplitude as read on the 400 CD. The receiver is calibrated for this frequency deviation and the data is recorded on the front panel. For instance, a deviation of 125 KC is proportional to an output of 87 volts RMS on Clark receiver.



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6.2.5 Read and record the DB of rejection to the carrier and 2nd upper sideband. The first upper sideband shall be 30 db above carrier and 2nd upper sideband.

6.2.6 Changing the input frequency from 80 CPS to 80 KUPS shall not change the output voltage as read on 4000 voltmeter more than +3 DB. Record this information.

6.2.7 Check distortion using the 330B at 1000 CPS modulation and 125 KC deviation. This value shall be less than 2%.

6.2.8 Turn B + down to 225 VDC and filament voltage to 5.7 volts. Measure output frequency, output power and modulation sensitivity. The limits appear on Manufacturing Test Data Form. The distortion under reduced voltages shall not exceed 3%.

6.2.9 Check for self oscillation by removing or shorting out the crystal (Y1). There shall be 0 power output for non oscillation.

#### VIBRATION

With an amplitude of 10g's peak or displacement of 0.1 inch, whichever is less, over the frequency range from 20 cps to 2000 cps, two (2) tests shall be made. The sweep time of these individual tests shall not exceed two (2) minutes:

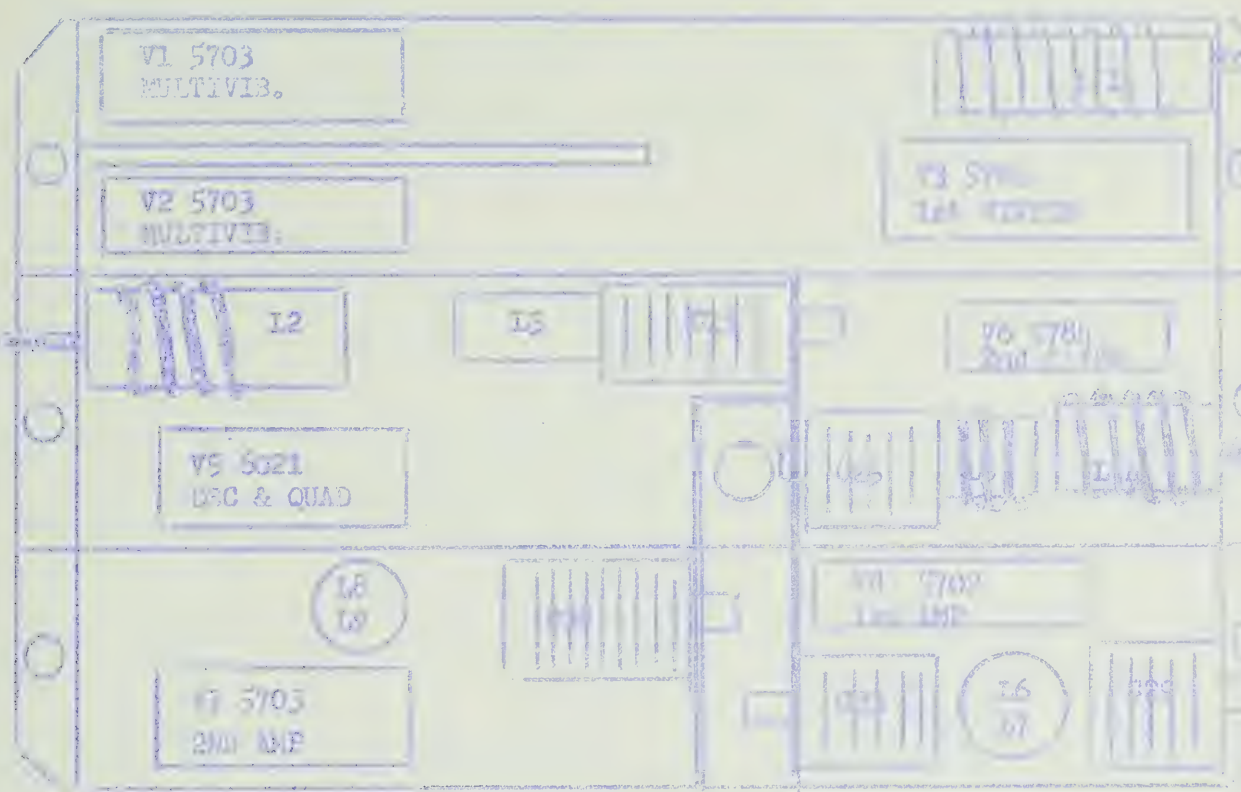
#### WITH MODULATION

Modulation sensitivity shall not change by more than 10%, that is, with 125 KC of deviation, the output voltage from the Clark receiver shall not change by more than 10%.

This completes test for transmitter . . . .



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Approved			ACCEPTANCE TEST PROCEDURE 13-154 FM TRANSMITTER



- |    |                           |            |     |                  |            |
|----|---------------------------|------------|-----|------------------|------------|
| L1 | 1st Mixer Plate           |            | C15 | Quad. Plate      |            |
| L2 | Xtal Oscillator Plate     | Adjustable | C25 | 2nd Mixer Plate  |            |
| L3 | 2nd Mixer Suppressor Grid |            | C29 | 1st Amp Plate    | Adjustable |
| L4 | Quad Plate                |            | C33 | 2nd Amp. Cathode |            |
| L5 | 2nd Mixer Plate           |            | C38 | 2nd Amp. Plate   |            |
| L6 | 1st Amp Plate             | Fixed      |     |                  |            |
| L7 | 2nd Amp Cathode           |            |     |                  |            |
| L8 | 2nd Amp Plate             |            |     |                  |            |
| L9 | Xntr Output               |            |     |                  |            |

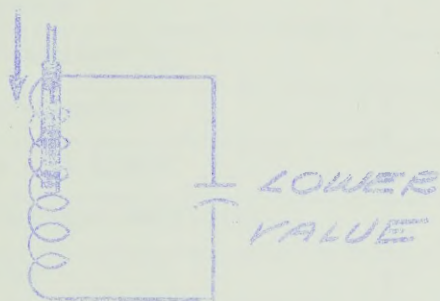


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Approved				13-184 FM TRANSMITTER			Report No.

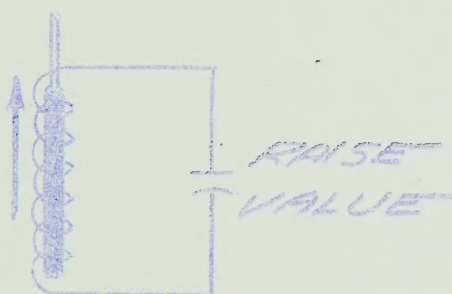
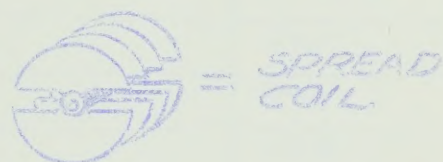
This illustration describes a method for gaining more control over the tuning frequencies ~~or~~ gain characteristics of an RF amplifier. If the occasion arises that a transmitter's maximum output is low or below 1.7 watts, one of the methods of bringing it up is by spreading or compressing the coils. This in effect changes the resonant frequency of the stage thereby increasing or decreasing the gain.

One of the indications when the transmitters' maximum output is lower than 1.7 watts, is a tuning capacitor that is completely unmeshed (as pictured on illustration 1) and therefore does not give complete control over the resonant frequency or gain of the unit.

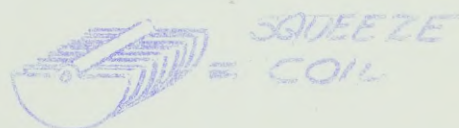
The remedy for this trouble is spreading the associated coil turns until capacitor is about half meshed and gain of stage is maximum. Conversely, if capacitor is completely meshed, the remedy is to squeeze the turns on the associated coil until the capacitor is about half meshed and stage gain is maximum as pictured on illustration 2.



LOWER  
VALUE



RAISE  
VALUE



This investigation was conducted in order to determine the effect of the various factors mentioned above on the rate of reaction. The results of the investigation are given in the following table. It is seen that the rate of reaction is increased by the presence of the various factors mentioned above. The rate of reaction is also increased by the presence of the various factors mentioned above.

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TITLE:  
FM TELEMETER TRANSMIT-  
TER 1004390

## MISSILE SYSTEMS DIVISION

ACCEPTANCE  
TEST PROCEDURE  
MO09887B

Sheet 10

TEST DATA

DATE: TEST DEPT: PLACE: PROJECT:

TEST PARAMETERS	TEST MEASUREMENTS		
	MINIMUM	ACTUAL	MAXIMUM
Aging	15 hr.		None
Filament Volts	6.3 V		6.3 V
Plate Volts	250 VDC		250 VDC
2nd Amplifier Plate Current	None		22 ma.
2nd Amplifier Grid Current	2 ma.		8 ma.
R. F. Power	1.7 Watts		2 watts
Center Frequency	-0.01% of *		+0.01% of *
Modulation Sensitivity	1.5 Vrms		3.0 Vrms
Rejection to Carrier	30 db		None
Rejection to 2nd Upper	30 db		None
Response: Maximum Deviation	-3 db		+3 db
Filament Volts	5.7 V		5.7 V
Plate Volts	225 VDC		225 VDC
R.F. Power	60% of #6		None
Center Frequency	-0.01% of * -.01% of #7		+0.01% of * +.01% of #7
Modulation Sensitivity	1.5 Vrms		120% of #8
Self Oscillation	0 watts		0 watts
ENVIRONMENTAL	MINIMUM		MAXIMUM
Axis of Vibration		VERT.	HORIZ. TRANS.
WITH MODULATION			
Modulation Sensitivity	0		+ 10% of #8
Deviation at Receiver			
Output			

## REMARKS:

\* Carrier Frequency listed on W.O. or Vehicle Instrumentation Schedule

OPERATOR:

INSPECTOR:

APPROVED:

DATE:

Date		Page		No.	
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